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ABSTRACT

The fifth of six instructional blocks in automotive mechanics, the lessons and supportive information in the document provide a guide for teachers in planning an instructional program in automotive tune-ups at the secondary and post secondary level. The material, as organized, is a suggested sequence of instruction within each block. Each lesson is stated in terms of a specific teaching objective, teaching aids, references, and an outline of information. Upon successful completion of the 30 lessons in the block of work, students will be able to: (1) generally define the occupational responsibilities of the tune-up specialist, (2) identify the systems requiring services recognized by automotive repairmen as being in the tune-up category, (3) define specifically the dependent and independent functions of these systems as they relate to overall vehicle performance, (4) analyze the performance of the systems and individual components to determine their functional effect within standardized specifications, and (5) correct diagnosed malfunctions by proper adjustment and necessary repairs or replacements. Included with the course outline are transparency masters and a reference guide listing related books, texts, and other publications. (MW)

ED 098405

AUTOMOTIVE MECHANICS INSTRUCTIONAL PROGRAM

BEST COPY AVAILABLE

BLOCK V

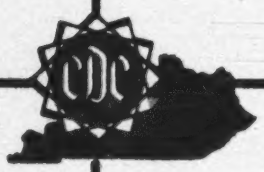
Tune Up

PREPARED FOR

Kentucky Industrial Education Teachers

IN COOPERATION WITH

Bureau of Vocational Education
State Department of Education
Frankfort, Kentucky



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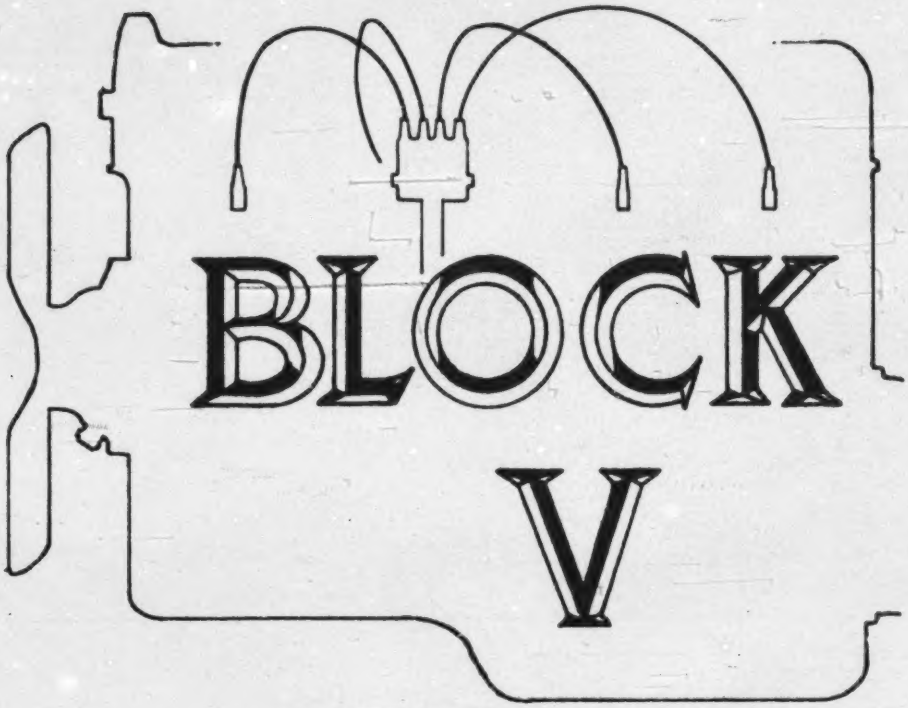

BLOCK V

Tune Up

General Teaching Objectives

Upon successful completion of the thirty lessons in this block of work, students will be able to:

1. Generally define the occupational responsibilities of the Tune-Up Specialist.

2. Identify the systems requiring services recognized by automotive repairmen as being in the Tune-up category.

3. Define specifically the dependent and independent functions of these systems as they relate to overall vehicle performance.

4. Analyze the performance of the systems and individual components to determine their functional effect within standardized specfications.

5. Correct diagnosed malfunctions by proper adjustment and necessary repairs or replacements.

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INFORMATION

Block: Tune-up

Block V
Job
Lesson

Lesson: Tune-up Service

Teaching Objective: Upon completion of this lesson, students will be able to generally define tune-up service and relate the basic types of services appropriate to the systems requiring attention.

Teaching Aids: Transparencies:
- Power and Ignition System, p. V-2
- Scope Patterns, p. V-6

References: Quick-Check Professional Tune-Up Procedure, Lincoln, St. Louis
AEA Tune-Up Manual, Automotive Electrical Association
Tune-Up Manual, Ignition Manufacturer's Institute

Outline of Information:

1. Definition of tune-up service

   a. Power and performance restoration
      -- Original standards (manufacturer's)
      -- Power, speed and acceleration
      -- Optimum economy through efficiency

   b. Preventative maintenance

2. Essentials

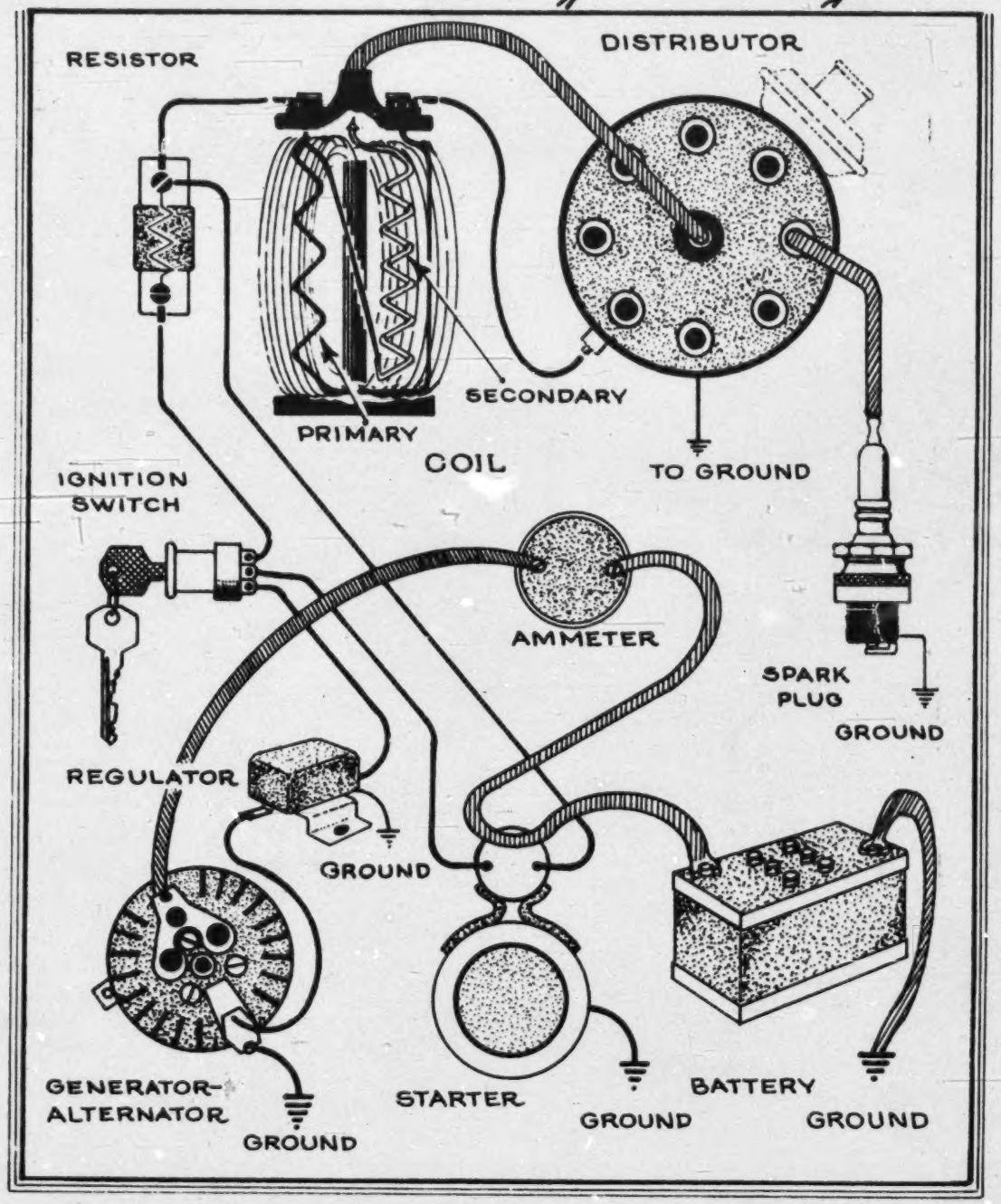
   a. Owner satisfaction through dependable functioning

   b. Technical services performed on system
      -- Cleaning
      -- Inspecting
      -- Analysis and specifications testing
      -- Adjusting
      -- Rebuilding
      -- Replacement

   c. Systems requiring services
      -- Ignition
      -- Compression
      -- Carburetion

   Note: It is generally recommended that ignition and compression services be performed before carburetion services, although all three systems must be included in analysis. For information pertaining to carburetion, refer to Block VI, "Fuel System."

POWER and Ignition System



INFORMATION

Block: Tune-up

Block V
Job
Lesson

Lesson: Ignition System Service

Teaching Objective: Upon completion of this lesson, students will be able to identify areas of inspection when analyzing ignition system conditions and will recommend appropriate corrective procedures.

Teaching Aids: Transparencies:
- Distributor, p. V-8
- Point Adjustment, Point Alignment, p. V-16
- Vacuum Advance System, p. V-10

Reference: Charging, Ignition and Cranking Systems, Delco-Remy

Inspection Routines:

1. Brittle or damaged spark plug wires should be replaced. All wires must be installed to proper spark plug. (See tune-up charts for firing order)

2. Tighten all ignition system connections

3. Replace or repair any wires that are frayed, loose or damaged

4. Distributor cap should be removed, cleaned and inspected for cracks, carbon tracks and burned or corroded terminals. Replace cap if necessary

5. The rotor should be cleaned and inspected for damage or deterioration. Replace cap if necessary

6. Distributor centrifugal advance mechanism (if used) should be checked by turning the distributor rotor in direction of running rotation as far as possible, then release rotor to see if springs return it to its retarded position. If rotor does not return readily, the distributor must be disassembled and the malfunction corrected.

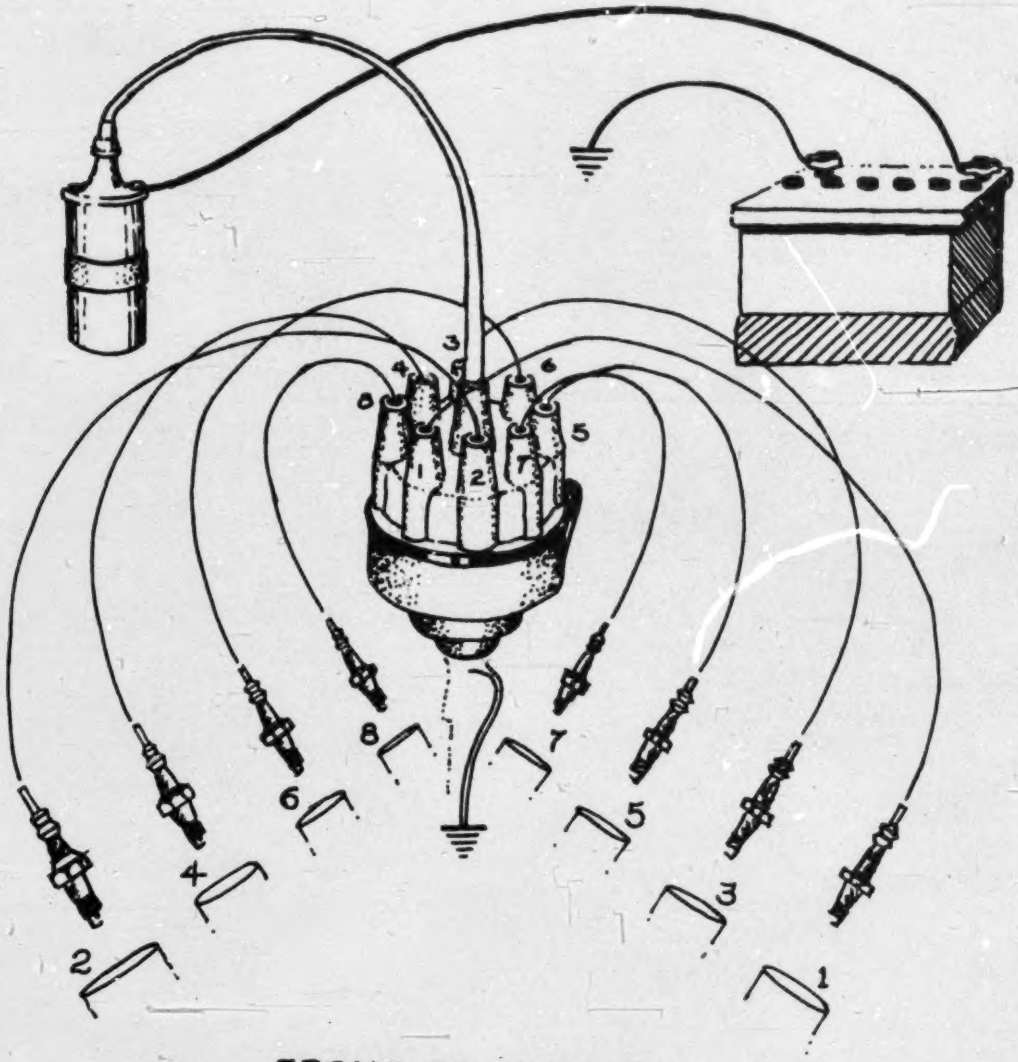
7. The vacuum spark control should be checked to see that it operates freely by turning the movable breaker plate (if used) or distributor housing in a direction opposite to that of running rotation to see if the spring returns it to the retarded position. Any stiffness in the operation of the spark control will affect ignition timing.

8. The distributor points should be examined and cleaned or replaced if necessary. Points with an overall gray color and only slight roughness or pitting need not be replaced.

9. Dirty points should be cleaned with a clean point file. The file should not be used on other metals and should not be allowed to become dirty or greasy, (never use emery cloth or sandpaper to clean points since particles will embed and cause arcing and rapid burning of points). Do not attempt to remove all roughness nor dress the point surfaces down smooth.

   Note: Spark plug service information and operations are adequately covered in block V on pages V-45 through V-52.

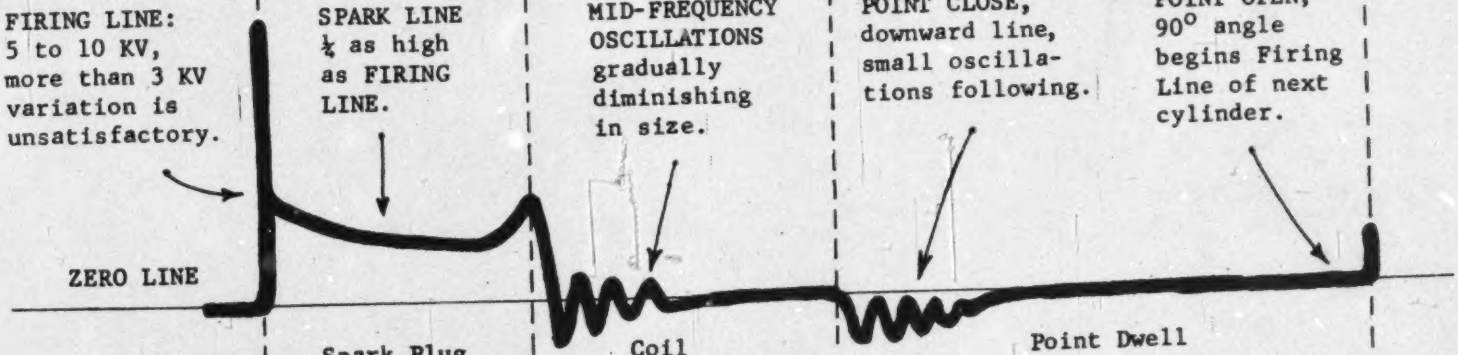
"IGNITION POWER CIRCUIT"



FRONT OF ENGINE

SCOPE PATTERN

Remove plug wire - FIRING LINE should climb to 20 KV or above for normal coil output. Pattern should extend below zero line indicating good insulation.


FIRING LINE: 5 to 10 KV, more than 3 KV variation is unsatisfactory.
SPARK LINE ½ as high as FIRING LINE.
MID-FREQUENCY OSCILLATIONS gradually diminishing in size.
POINT CLOSE, downward line, small oscillations following.
POINT OPEN, 90° angle begins Firing Line of next cylinder.
ZERO LINE

Spark Plug firing area

Coil Reference Section

Point Dwell Section

CHECK
Plug gap, rotor gap, fuel mixture, wire condition.

CHECK:
Wires, rotor, cap, plugs, engine condition affecting plug firing.

CHECK FOR:
Defects in condenser, primary circuit, coil

CHECK FOR:
Improper contact due to weak point tension, burned points, dirty points, misalined points, pitted points, arcing due to condenser failure.

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INFORMATION

Block: Tune-up

Block V
Job
Lesson

Lesson: Ignition Distributor

Teaching Objective: Upon completion of this lesson, students will be able to define the purpose and describe the construction of a typical automotive ignition distributor.

Teaching Aids: Transparencies:
- Distributor, p. V-8
- Vacuum Advance System, p. V-10

References: Charging, Ignition and Cranking Systems, Delco-Remy
Auto Service and Repair, Stockel, 1969, Chapter 21

Outline of Information:

1. Purpose

   a. The distributor opens and closes the coil primary circuit by operation of the contact points.

   b. The high voltage surge is distributed to the correct cylinder spark plug at the correct time.

2. Construction

   a. A breaker cam is used to actuate the contact points.

   b. The breaker cam, which is on the distributor shaft is driven at one-half of the engine speed by the camshaft.

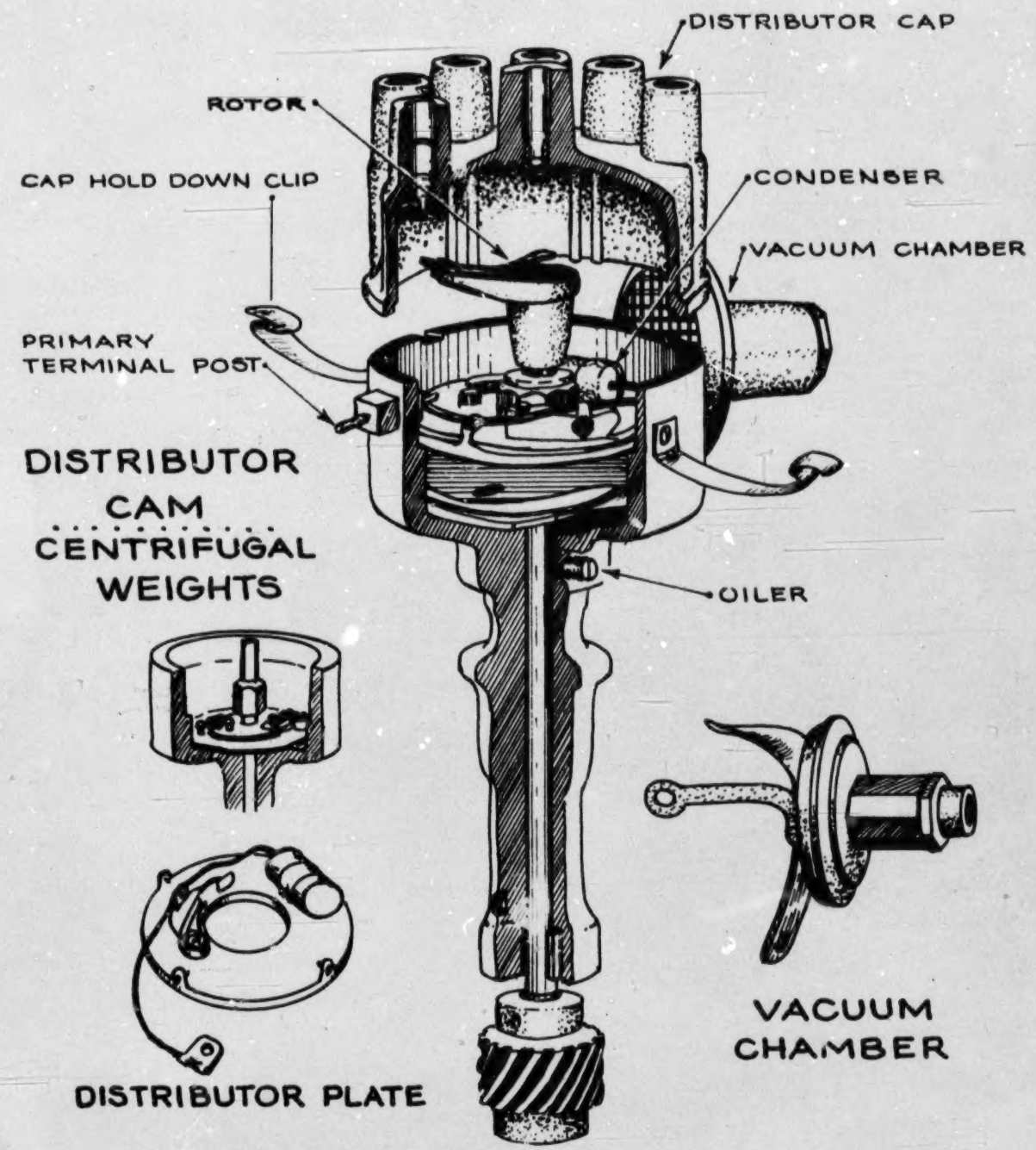
   c. The breaker cam has the same number of lobes as there are cylinders in the engine causing the points to break contact in order to provide spark to each cylinder in order of fire.

   d. Vacuum advance in conjunction with centrifugal advance provides additional spark advance when cylinder compression ratio is in lower ranges.

   e. Distributor body houses rotor and condenser.

   f. Distributor cap protects system from climate changes, engine operating environment, dirt, grease, etc., and provides terminals for secondary cable connections.

DISTRIBUTOR



INFORMATION

Block: Tune-up

Block V
Job
Lesson

Lesson: Ignition Distributors

Teaching Objective: Upon completion of this lesson, students will be able to identify the areas of general inspection when servicing the automotive ignition distributor and describe corrective steps where necessary.

Teaching Aids: Transparencies:
- Distributor, p. V-8
- Vacuum Advance System, p. V-10
- Point Adjustment, Point Alignment, p. V-16
- Distributor, Contact Point Dwell, p. V-20

References: Charging, Ignition and Cranking Systems, Delco-Remy
Auto Mechanics, Glenn, Chapter 10

Outline of Information:

1. Contact points

   a. Points must be aligned properly. The points must face squarely.

   b. Thoroughly remove any grease or foreign material from face of points

   c. Be sure primary lead and condenser wires are well insulated and free to move with the breaker plate

2. Distributor shaft and housing

   a. Any excess wear on the shaft or housing bushing will result in improper point adjustment.

   b. Always lubricate the shaft and bushing after cleaning as the lubricant is washed away in cleaning

   c. Be sure to lubricate the breaker cam lobes to prevent excessive wear on the contact point rubbing block

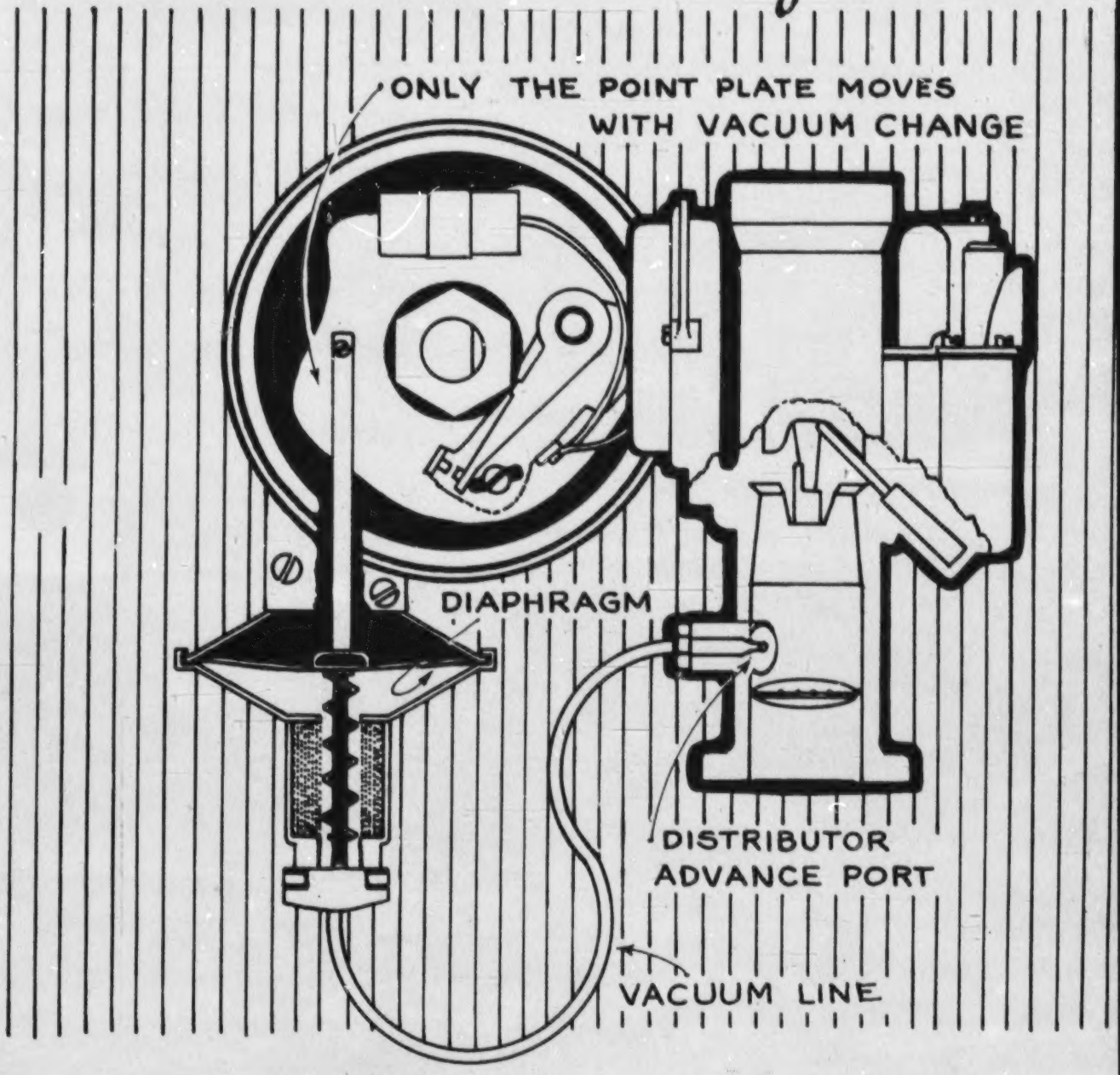
3. Vacuum advance unit

   a. Always check the diaphragm action and compare with specifications

   b. Check lines and fittings for possible leakage

   c. Spring tension can be varied by adding or removing spacing washers.

Vacuum Advance System



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OPERATION

Block: Tune-up

Block V
Job
Operation

Operation: Testing Distributor (Off-Vehicle Method)

Teaching Objective: To teach students to test dist-ibutors when removed from engine.

Tools: Screwdriver, needle-nose pliers

Materials: Wipe cloths, Manual for test machine being used

Teaching Aids: Distributor Machine

References: Vehicle Service Manual
Automechanics, Glenn, Chapter 10

Steps:

1. Distributor test method

   a. With the distributor mounted on a distributor testing machine, connect the dwell meter to the distributor primary lead

   b. Turn the adjusting screw to set the dwell angle to 30 degrees

2. Test Light Method

   a. With the distributor mounted in a vise, connect a testing lamp to the primary lead

   b. Rotate the shaft until one of the circuit breaker cam lobes is under the center of the rubbing block of the breaker lever

   c. Turn the adjusting screw clockwise until the lamp lights, then give the wrench 1/2 turn in the opposite direction (counter-clockwise) to obtain the proper dwell angle

OPERATION

Block: Tune-up — Block V
Job
Operation: Inspecting and Servicing Ignition Distributor — Operation

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Teaching Objective: To teach students to inspect and perform basic services on ignition distributors

Tools: Ignition wrench set, screwdriver, feeler gauge, distributor machine

Materials: Points, condenser, cam lobe lubricant, cleaning solvent, oiler with 20W, wipe cloths, compressed air supply

Teaching Aids: Automobile, engine on stand, practice distributors

References: Auto Service and Repair, Stockel, 1969, Chapter 21
Motor's Repair Manual
Tune-Up Manual, Ignition Manufacturer's Institute
Vehicle Service Manual

Steps:

1. Remove distributor
2. Wash all parts in cleaning solvent except cap, rotor, condenser, breaker plate assembly and vacuum control unit

   Note: Degreasing compounds may damage insulation of these parts or saturate the lubricating felt in the case of the breaker plate assembly.
3. Dry distributor with compressed air
4. Mount distributor in vise or testing machine
5. Remove rotor
6. Remove contact points mounting screws
7. Disconnect condenser and primary wire
8. Remove points
9. Remove condenser attaching screw
10. Remove condenser

11. Inspect the breaker plate assembly for damage or wear and replace if necessary

12. Inspect the shaft for wear and check its fit in bushing in the distributor body. If the shaft or bushings are worn, the parts should be replaced.

13. Mount the shaft in "V" blocks and check the shaft alignment with a dial gauge. The runout should not exceed .002".

14. Inspect the advance weights for wear or burrs and fit on their pivot pins

15. Inspect the cam for wear or roughness. Then check its fit on the end of the shaft. It should be absolutely free without any roughness.

16. Inspect the condition of the distributor points. Dirty points should be cleaned and badly pitted points should be replaced.

17. Test the condenser for series resistance, microfarad capacity (.18 to .23) and leakage or breakdown, following the instructions given by the manufacturer of the test equipment used.

18. Inspect the distributor cap and wires for damage and replace if necessary.

19. Install new condenser, if necessary

20. Connect primary wire and condenser lead to point terminal

21. Using feeler gauge or distributor machine, set point gap to specifications

22. Lubricate distributor cam lobes

23. Moisten felt wick oiler under rotor

24. Fill outside reservoir

25. Oil centrifigual advance unit

    Note: Oil distributor parts sparingly

OPERATION

Block: Tune-up

Operation: Adjusting ignition point gap

Block V
Job
Operation

Teaching Objective: To teach students to adjust ignition point gap

Tools: Ignition point alignment tool, ignition wrench set, ignition points, ignition thickness gauge

Materials: Wipe cloths

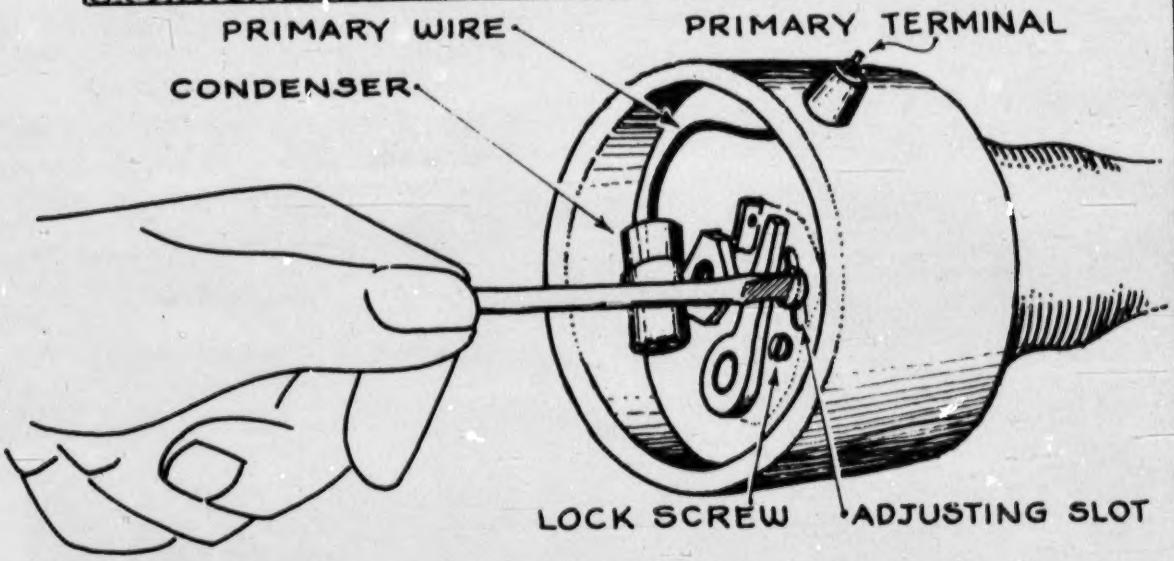
Teaching Aids: Automobile or engine on stand
Transparencies:
- Point Adjustment, Point Alignment, p. V-16
- Points Adjustment, p. V-15

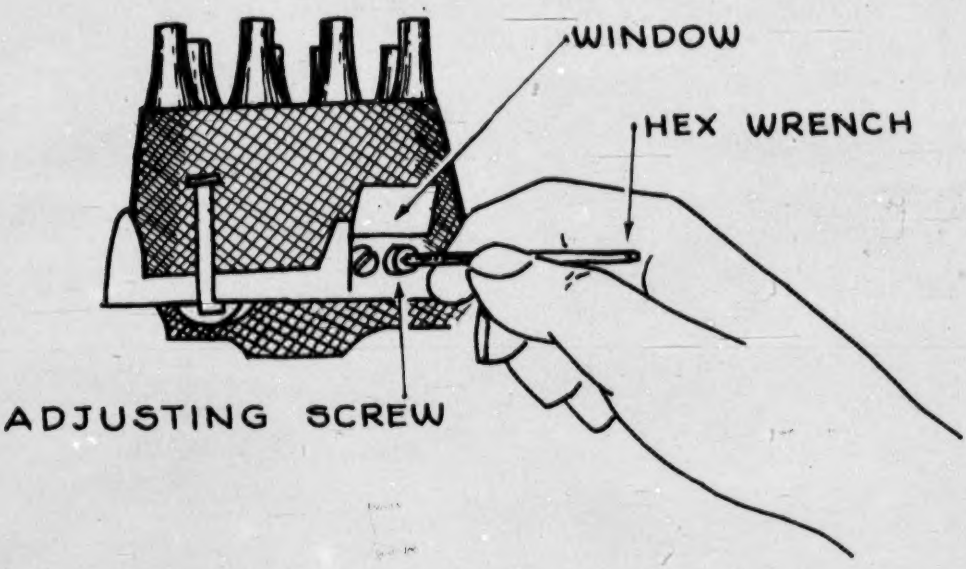
References: Automotive Essentials, Kuns, Chapter 9
Quick Check, Manual No. 349, Lincoln, St. Louis, p. 5

Steps:

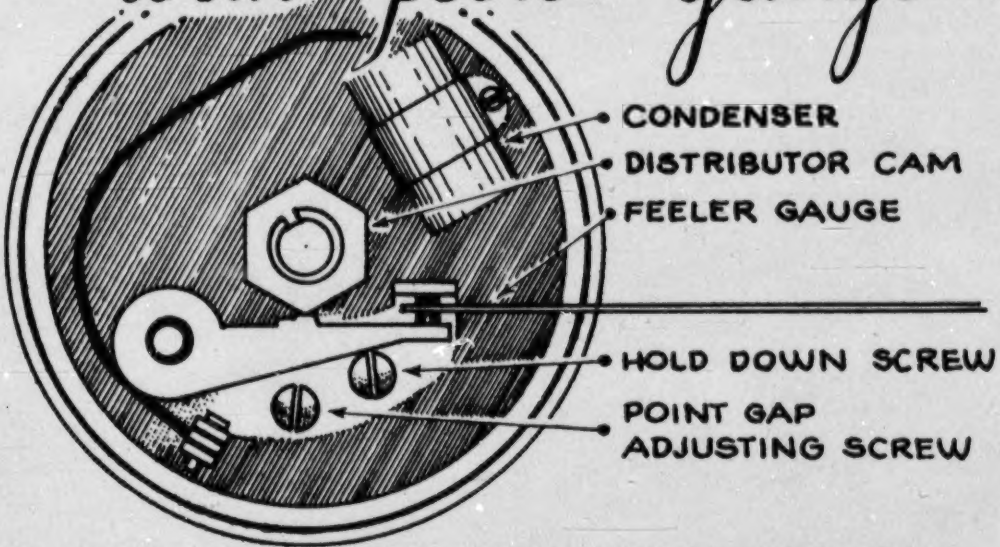
1. Secure manufacturer's specifications for the distributor
2. Remove the distributor cap and spark plug wires
3. Remove the distributor rotor
4. Examine the ignition points. If the contacts are pitted or worn, they should be replaced. Check the alignment of the contact faces, correct the alignment if necessary.
5. Crank the engine until the breaker arm cam follower (rubbing block) rests on the peak of the cam and the points are opened to maximum
6. Loosen the clamping screw on the adjustable contact arm
7. Turn the contact arm adjusting screw until the correct blade will slide easily between the point faces, while preventing admission (with ease) of a +.001 blade
8. Tighten the contact arm clamping screw and recheck the clearance
9. Replace the distributor rotor. Be sure that the rotor driving lug is in the notch on the distributor shaft.
10. Replace the distributor cap and spark plug wires. Be sure that the cap positioning lug is in the notch on the distributor housing.

Points Adjustment



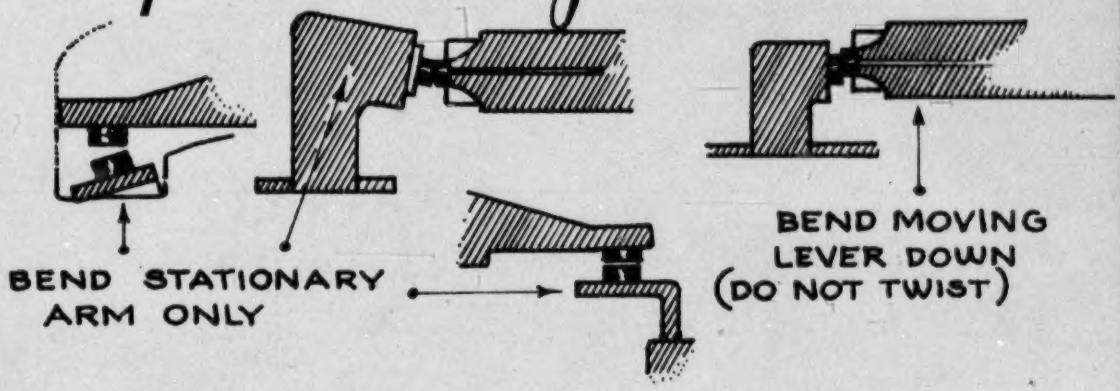


point adjustment with feeler gauge



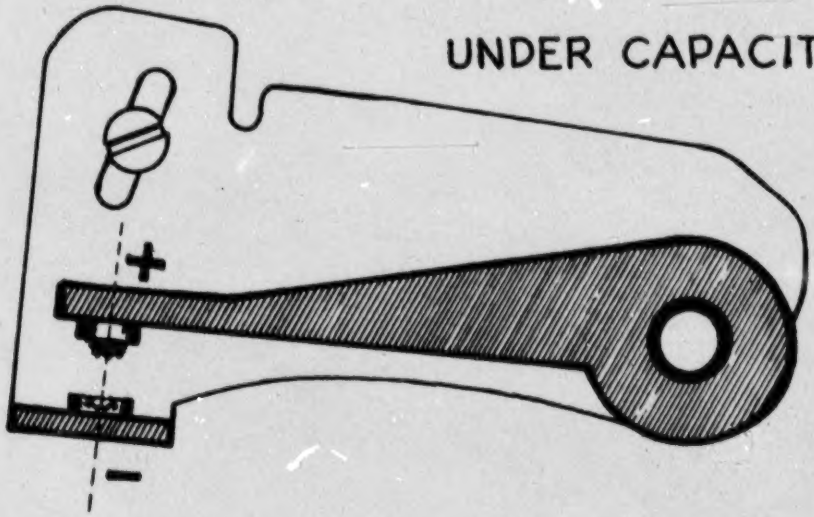
1. RUBBING BLOCK IS SET ON HIGH POINT OF CAM
2. GAP ADJUSTED TO LIGHT DRAG ON GAUGE
3. TIGHTEN HOLD DOWN SCREW

point alignment

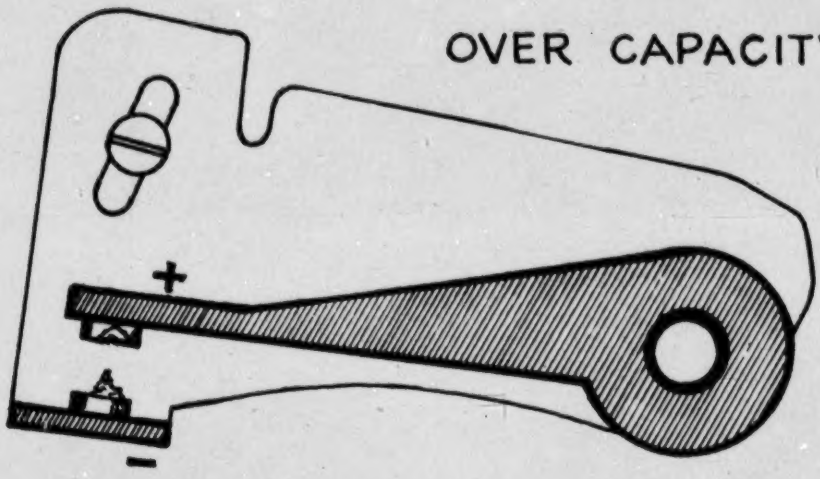


Contact Point Pitting

UNDER CAPACITY



OVER CAPACITY



INFORMATION

Block: Tune-up

Block V
Job
Lesson

Lesson: Distributor Cap

Teaching Objective: Upon completion of this lesson, students will be able to define the purpose and function of the ignition distributor cap and describe its construction.

Teaching Aids: Transparency:
- Distributor, p. V-8

References: Charging, Ignition and Cranking Systems, Delco-Remy
Auto Service and Repair, Storkel, 1969, pp. 21-8 - 21-10

Outline of Information:

1. Purpose and Function

   a. To transfer secondary voltage from coil to spark plugs via secondary cables

   b. Provide protection from dirt and moisture for distributor components

   c. Center tower contact transfers coil impulse to rotor.

   d. Satellite tower terminals receive secondary impulse from rotor for transfer to spark plug wires.

2. Construction

   a. Molded "Bakelite" or other tough plastic

   b. Terminal posts are molded into cap and accurately machined for precise rotor contact.

   c. Center tower contact is carbon rod.

OPERATION

Block: Tune-up — Block V

Job

Operation: Installing Distributor in an Undisturbed Engine (all models) — Operation

Teaching Objective: To teach students to install a distributor in an engine which has been undisturbed

Tools: Distributor wrench (1/16"), ignition set and needle-nose pliers

Materials: Wipe cloths

Teaching Aids: Automobile or engine on stand

References: Vehicle Service Manual
Auto Service and Repair, Stockel, 1969, 21-19 - 21-21

Steps:

1. Locate No. 1 piston in firing position by either of two methods described below.

   a. Remove No. 1 spark plug and with finger on plug hole, crank engine until compression is felt in the No. 1 cylinder. Continue cranking until time mark on crankshaft pulley lines up with timing tab attached to engine front cover.

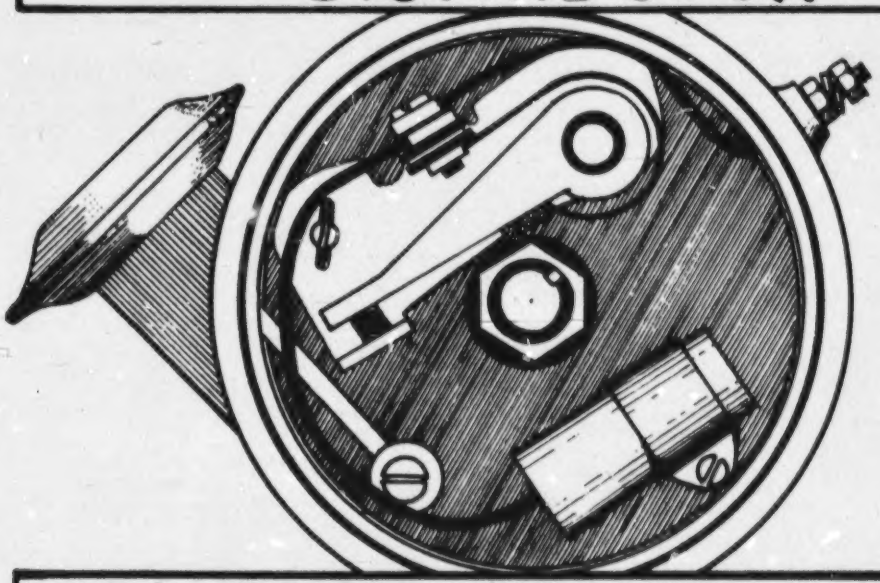
   b. Remove rocker cover (left bank on V8 engines) and crank engine until No. 1 intake valve closes and continues to crank slowly about 1/3 turn until timing mark on pulley lines up with timing tab.

2. Position distributor to opening in block (normally installed attitude) noting position of vacuum control unit

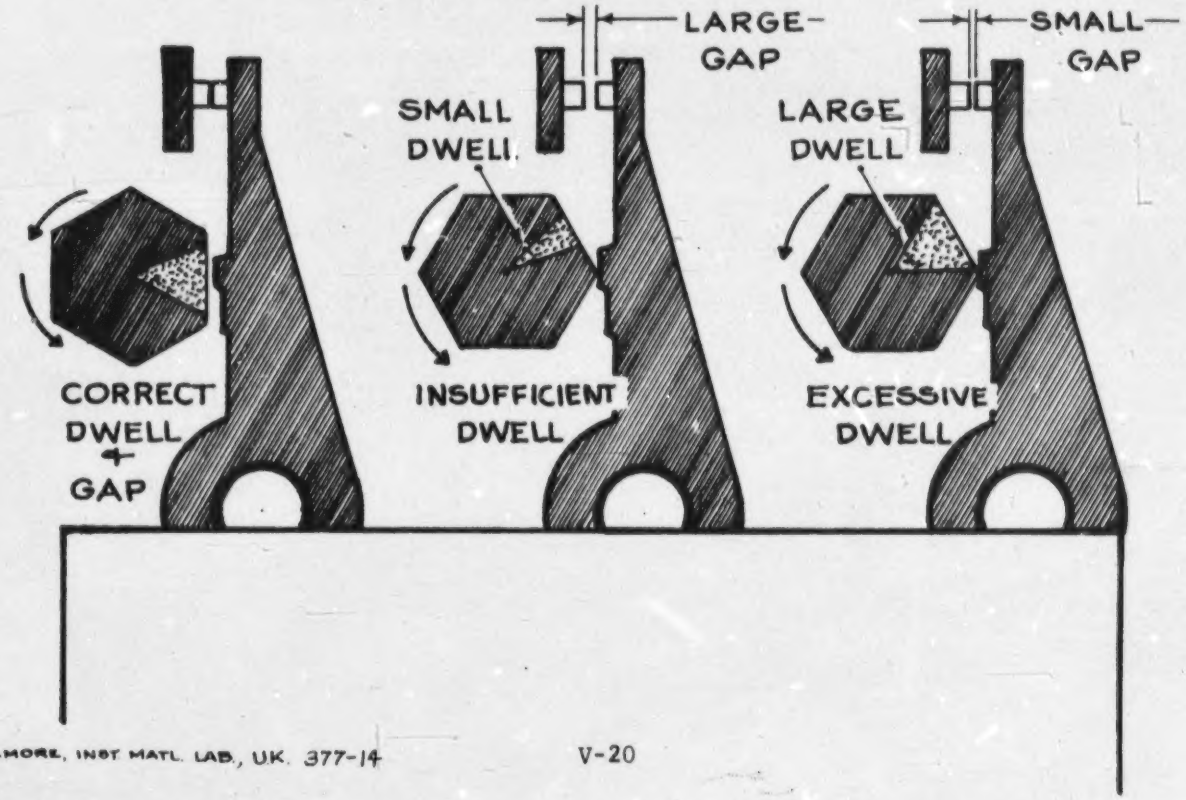
3. Position rotor to point toward front of engine (with distributor housing held in installed attitude), then turn rotor counter clockwise approximately 1/8 turn more toward left cylinder bank and push distributor down to engine camshaft. It may be necessary to rotate rotor slightly until camshaft engagement is felt.

4. While pressing firmly down on distributor housing, kick starter over a few times to make sure oil pump shaft is engaged. Install hold-down clamp and bolt and tighten bolt.

DISTRIBUTOR



CONTACT POINT DWELL



INFORMATION

Block: Tune-up — Block V
Job
Lesson: Condensers — Lesson

Teaching Objective: Upon completion of this lesson, students will be able to describe the construction and define the functional characteristics of automotive ignition condensers.

Teaching Aids: Sample condensers (new, cutaway, disassembled)
Transparencies:
- Ignition Coil, Condenser, p. V-28
- Condenser Function, p. V-23

References: Principles of Automotive Tune-up, C. F. Niehoff and Company
Automotive Mechanics, Crouse, Chapter 15

Outline of Information:

1. Condensers are made from several wrappings of aluminum foil. These aluminum conductors have layers of insulation between each wrapping.
   a. The condenser acts as a storage tank and prevents point arcing.
   b. The capacity of a condenser is determined by the vehicle manufacturer and must be replaced accordingly.
   c. Current does not flow through a good condenser.
   d. The capacity of a condenser is measured in MFG.
2. Condensers are tested for leakage resistance and capacity.
   a. If a condenser is low in capacity, the engine will operate satisfactorily at high speed--excessive arcing will occur at low speeds.
   b. If the condenser capacity is too high, in high speed performance will be affected.

INFORMATION

Block: Condenser — Block V

Job

Lesson: Condenser Performance Diagnosis — Lesson

Teaching Objective: Upon completion of this lesson, students will be able to identify the factors of engine performance related to condenser functioning and to specify areas of diagnosis.

Teaching Aids: Sample condensers - disassembled to show construction
Transparencies:
- Condenser Functions, p. V-23
- Ignition Coil, Condenser, p. V-28

Outline of Information

1. The following factors affect condenser performance and each factor must be considered in making any condenser test.

   a. Breakdown - a failure of the insulating material. A direct short between the metallic elements of the condenser. This prevents any condenser action.

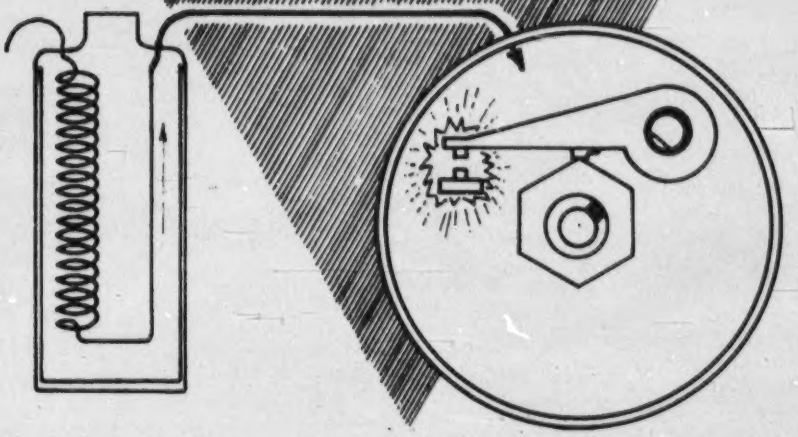
   b. Low insulating resistance (leakage) - low insulation resistance prevents the condenser from holding a charge. All condensers are subject to leakage which, up to a certain limit, is not objectionable.

   c. High series resistance - excessive resistance in the condenser circuit due to broken strands in the condenser or to a defective connection. This will cause burned points and ignition failure upon initial starts and at high speeds.

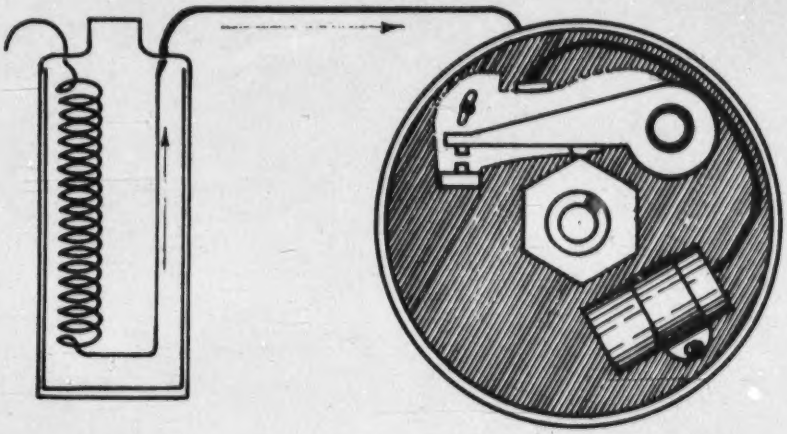
   d. Capacity - capacity is determined by the area of the metallic elements and the insulating and impregnating materials.

      Note: For a complete check of the condenser, use a tester which will check for all of the above conditions. Follow the instructions given by the manufacturer of the test equipment. Condenser capacity should be .18-.23 microfarads.

CONDENSER FUNCTION



THE ABSENCE OF A CONDENSER IN THE PRIMARY CIRCUIT ALLOWS CURRENT FLOW TO CONTINUE, CAUSING ARCING BETWEEN CONTACT POINTS



THE CONDENSER PROVIDES A TEMPORARY RESIDENCE FOR THE CURRENT, REDUCING ARCING BETWEEN CONTACT POINTS

OPERATION

Block: Tune up

Operation: Testing Condensers

Block V
Job
Operation

Teaching Objective: To teach students to test condensers

Tools: Sun diagnosis engine tester

Materials: Sample condensers

Teaching Aids: Transparencies:
- Ignition Coil, Condenser, p. V-28
- Condenser Function, p. V-23

References: Sun Engine Diagnosis Manual
Automechanics, Glenn, Chapter 10

Steps:

1. Turn volt-ohm selector switch to condenser test position

2. Connect the condenser test leads together and calibrate

3. Connect the condenser test leads, one to the primary terminal of the distributor and the other test lead to ground on the distributor body

   Note: If condenser is removed from distributor, connect one lead to condenser body and the other lead to the pigtail

4. With the condenser test switch in series resistance position, the meter should read in black bar at the right end of scale.

   a. Move the condenser pigtail. If a deflection of the meter is noted, the pigtail is making poor contact and the condenser should be replaced.

   b. If the reading is outside of the black bar, move the grounded test lead to the body of the condenser. If the reading improves, the condenser is not properly grounded to the distributor housing.

Leakage Test

1. Turn the condenser test switch to leakage position

2. The meter should now read in the black bar at the left end of the scale if condenser insulation is satisfactory.

   a. If meter pointer reads outside of the black bar, the condenser is leaking and the condenser should be replaced.

   b. Refer to Manufacturer's specifications for recommended condenser capacity

Capacity Test (Microfarad)

1. Turn condenser test switch to CAPACITY position

2. Read BLACK scale of meter (0-to 1.0) for the microfarad capacity of the condenser being tested

   a. If tester reading in microfarads does not fall within tolerances specified, the condenser should be replaced.

   b. If the condenser does not meet specifications while mounted in the distributor, remove the condenser and retest it

   Note: The same procedure is followed whether testing condensers in or out of the vehicle. If the condenser tests "bad" in the distributor, but tests "good" when removed, there is a short or ground in the distributor primary circuit. Inspect the insulation of the distributor primary terminal and the internal circuit of the distributor.

INFORMATION

Block: Tune-up

Lesson: Ignition Coil

Block V
Job
Lesson

Teaching Objective: Upon completion of this lesson, students will be able to relate the functions of the ignition coil to certain specific operational facts and to identify essential parts in the construction of the coil.

Teaching Aids: Transparencies:
- Ignition Power Circuit, p. V-5
- Ignition Coil, Condenser, p. V-28
- Power and Ignition System, p. V-2

References: An Introduction to the Automotive Electrical System, Delco-Remy
Fundamentals of Service, Electrical Systems, John Deere, Chapter 6
Related Science, Automotive Trades, Jensen and Brazier, Section III
Charging, Ignition and Cranking Systems, Delco-Remy
Auto Service and Repair, Stockel, 1969
20,000 Volts Under the Hood, Delco-Remy

Outline of Information:

1. Function of ignition coils

   a. Step-up basic system (battery) voltage (12 volts) to high voltage required at spark plugs to ignite air-fuel mixture
      -- Step-up (pulse) transformer
      -- Primary induced voltage 250 to 300 volts
      -- Secondary output voltage 12,000 to 30,000 volts

   b.

2. Operational facts

   a. Magnetic field around primary winding takes a minute fraction of a second to build field strength.

   b. Primary winding voltage helps charge condenser faster and consequently stops current flow faster in primary circuit.

   c. Iron core in a transformer serves to concentrate magnetic field strength.

   d. Secondary voltage will go only as high as is necessary to jump the spark plug gap.

   e. Jumping the spark plug gap completes the secondary circuit.

3. Construction

a. Primary winding
   -- Few hundred turns of heavy wire wrapped around secondary winding
   -- Connecting ends of winding are connected to primary terminals.

b. Secondary winding
   -- Many thousands of turns of fine wire wrapped around iron core

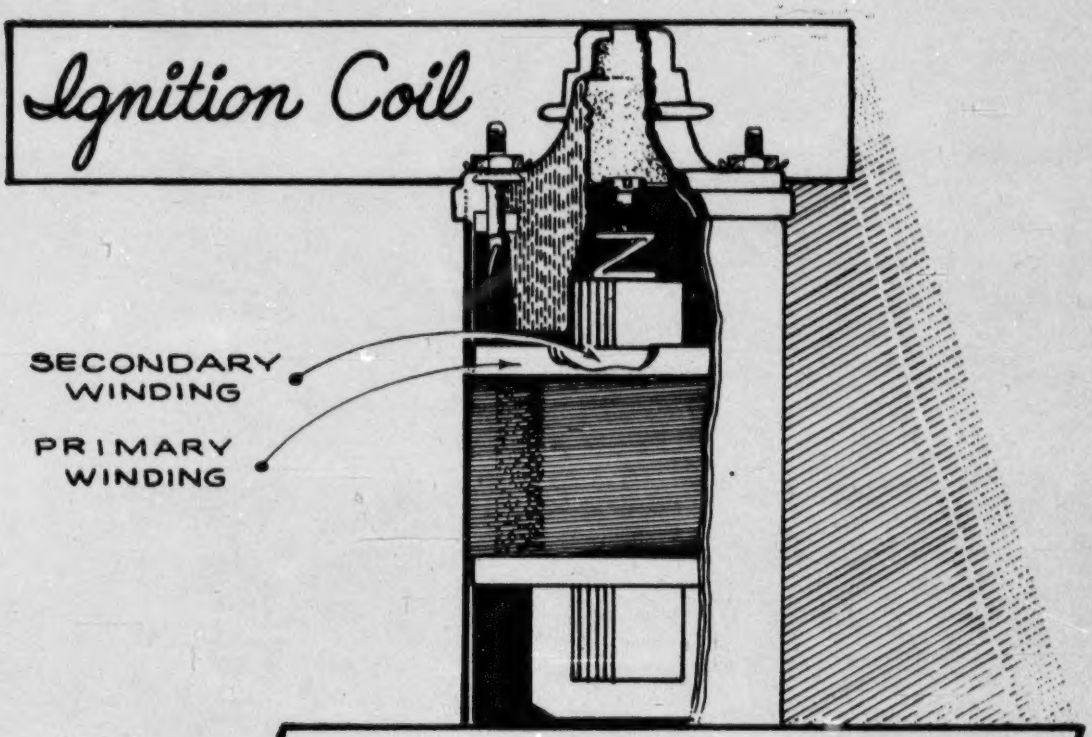
c. Iron core
   -- Laminated soft-iron especially produced for constructing transformers

d. High-tension terminal
   -- Connected to output side of secondary winding

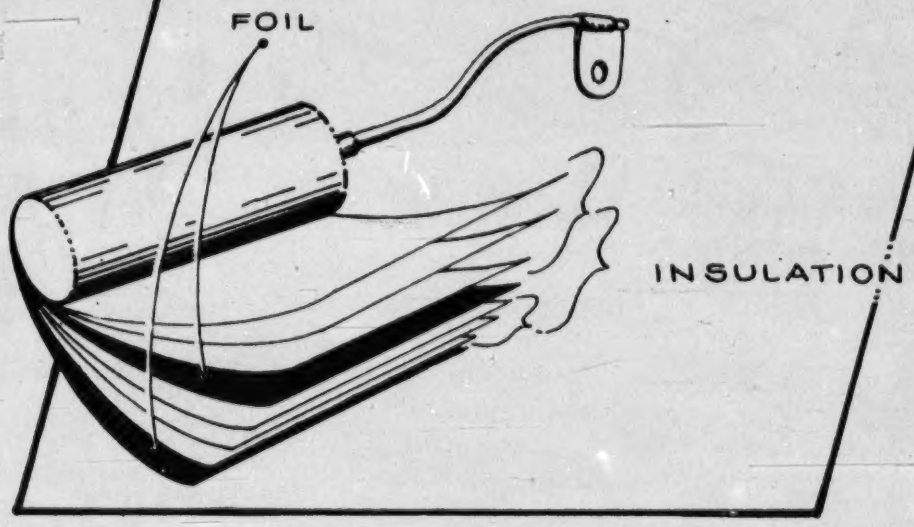
e. Primary terminals
   -- One terminal receives power from battery.
   -- Other terminal connects to distributor points.

f. Casing
   -- Metal container around a laminated shell
   -- Filled with oil or other insulating material
   -- Cap is a molded bakelite or other insulating material.
      (1) The two primary terminals and the high tension terminal are molded into cap.

Ignition Coil



Condenser



OPERATION

Block: Tune-up

Block V
Job
Operation

Operation: Testing Ignition Coils

Teaching Objective: To teach students to test ignition coils

Tools: Sun diagnosis engine tester, pickup extension, socket wrench set (1/4"),

Materials:

Teaching Aids: Automobile, engine on stand, practice coils

References: Auto Service and Repair Manual, Stockel, 1969, pp. 21-4 - 21-6
Sun Instruction Manual

Steps:

Note: If coil resistance tests are to be made while the coil is mounted in the vehicle, it must be electrically insulated from the vehicle's electrical system by disconnecting the primary leads from its terminals and removing the secondary lead from the distributor.

1. Primary Resistance Test

   a. With the volt and ohm selector switch set in the OHM X1 position, calibrate the ohmmeter

   b. Connect the volt and ohm leads, one to each coil primary terminal

   c. Observe meter reading and compare with specifications

2. Coil Primary Ground Test

   a. Connect volt and ohm test leads; one to either coil primary connection and the other to the coil case

   b. Turn volt and ohm selector to X1000 position

   c. Ohmmeter should show no meter movement. Any meter indication will indicate a grounded primary winding.

3. Secondary Resistance Test

   a. With the volt and ohm selector switch set in X1000 position, calibrate the ohmmeter

   b. Install pickup extension in tower of coil

   c. Connect ohmmeter test leads, one to either primary terminal of the coil and the other to the end of the pickup extension adapter in the coil tower

   d. Observe meter reading and compare with coil specifications

      Note: To completely test the coil, the ignition coil test must also be made

4. Ignition coil test

   a. Place coil in coil holder:

      Note: Coil may be tested on the vehicle by removing vehicle's primary leads and high tension lead.

   b. Connect volt-ohm-coil leads to coil primary terminals, observe polarity

   c. Insert the pattern pickup into the secondary coil tower

   d. Connect the ground lead of the pickup to ground

   e. Rotate ohm-coil calibrator fully counter-clockwise

   f. Set scope trigger switch of wiring junction unit to coil test position

   g. Adjust scope and then turn the circuit selector switch to the secondary position and pattern selector to display position

   h. Turn coil test selector counter-clockwise to standard coil for conventional ignition coils or clockwise to transistor coil for transistor ignition coils

i. Adjust the PATTERN LENGTH control until a complete single wave form is expanded across the screen

j. Rotate OHM-coil calibrator clockwise until the highest portion of the wave form reaches 24 KV. Do not exceed 23 KV unless specified by manufacturer, otherwise coil may be damaged.

Note: If the first oscillation of the wave form points down, reverse the test leads to the coil primary.

k. Observe wave forms and note oscillations.

OPERATION

Block: Tune-up

Block V
Job
Operation

Operation: Replacing Ignition Coil

Teaching Objective: To teach students how to replace ignition coils

Tools: Ignition set, Combination wrenches, (7/16", 1/2", 9/16"), distributor wrench (9/16")

Materials: Wipe cloths

Teaching Aids: Automobile or engine on stand

References: Vehicle Service Manual

Steps:

1. Disconnect ignition switch and distributor leads from terminals on coil
2. Remove secondary ignition cable from center tower of coil
3. Remove the two coil support mounting bolts or loosen friction clamp screw and remove coil
4. Place new coil in position and install attaching bolts or tighten clamp screw
5. Place secondary lead securely in center tower making certain that protective boot is in place
6. Attach primary leads to primary terminals and tighten terminal nuts
7. Start engine and test coil operation

INFORMATION

Block: Tune-up

Block V
Job
Lesson

Lesson: Ignition Resistors

Teaching Objective: Upon completion of this lesson, students will be able to generally define the purposes of ignition resistors and recognize the two most common types.

Teaching Aids: Transparency:
- Power and Ignition System, p. V-2

References: Automotive Encyclopedia, Goodheart-Wilcox
Charging, Ignition and Cranking Systems, Delco Remy, 1964
Motor's Auto Repair Manual

Outline of Information:

1. Purposes

   a. Prolong service life of breaker points
      -- Full 12 volt power supply to ignition system during cranking through resistor by-pass
      -- While engine is running the resistor reduces battery voltage to coil.
      -- Limits to a safe maximum the primary current flow through coil and contact points
      -- Protects against excessive build up of primary current when the ignition switch is closed with engine stopped and contact points closed

   b.

2. Specific function and types of resistors

   a. Electricity flows from the ignition switch to the resistor.
      -- Not all systems utilize a resistor in the primary circuit.
      -- Resistors are not common in 6-cylinder ignition circuits.
      -- External
         (1) Block mounted on the fire wall near the ignition coil
         (2) Ignition starter wire is connected to the coil side of resistor (Chrysler products).
      -- Internal
         (1) Resistance wire as an integral part of the wiring harness
      -- Resistor made inside the coil

Ignition Resistors (Continued)

b. There are resistors designed for specific jobs
   -- One type, used on Ford V engines for many years, was a simple unit used to reduce battery voltage reaching the coil.
      (1) Primary circuit passed through resistor cutting down voltage to a predetermined level
      (2) The type of coil utilized in these installations would overheat if battery voltage reached coil without being reduced

OPERATION

Block: Tune-up

Operation: Testing Resistors

Block V
Job
Operation

Teaching Objective: To teach students to test ignition resistors with a test light

Tools: 12 volt test light

Teaching Aids: Automobile or engine on stand

Reference: Motor's Auto Repair Manual, 1969, 1-24 - 1-28

Steps:

1. Close ignition points
2. Turn on ignition switch
3. Connect clip end of test light to a good ground
4. Touch the other lead of test light to battery side of resistor (light should be bright)
5. Move test end lead to the coil side of the resistor (light should be dim)
6. Turn off ignition switch

Note: If step 5 does not work properly check to see if the ignition points are closed

OPERATION

Block: Tune-up

Operation: Testing Compression

Block V
Job
Operation

Teaching Objective: To teach students how to test compression

Tools: Spark plug wrench, compression gauge

Materials: Wipe cloths

Teaching Aids: Manufacturer's Manual for Engine Being Serviced

References: Auto Service and Repair, Stockel, 23-3 - 23-4

Steps:

1. Start engine and warm up
2. Shut off engine
3. Remove all spark plug wires
4. Loosen spark plugs using proper wrench
5. Blow all dirt and foreign material from around base
6. Remove spark plugs
7. Connect jumper wire between distributor terminal of coil and ground on engine to avoid high tension sparking while cranking engine and turn ignition switch on
8. Insert rubber fitting of compression gauge into a spark plug part and hold gauge tightly in position
9. Push throttle wide open and crank engine until compression gauge reaches its highest reading, which should require only a few revolutions of engine

   Note: The compression gauge hand should jump to about 75 pounds on the first compression stroke, with a few more strokes giving maximum pressure.

10. Repeat test on each cylinder
11. Compare results with manufacturer's specifications
12. Put a small amount of lubricating oil in each cylinder

Testing Compression (Continued)

13. Repeat test on each cylinder

14. Note difference in reading and record

15. Replace spark plugs using new gaskets

16. Install spark plug wires

Note: Differences of 15 or more pounds pressure between cylinders indicates troublesome conditions that most likely cannot be corrected by tune-up procedures. Refer to car manufacturer's shop manual for specifications

OPERATION

Block: Tune-up

Operation: Testing Vacuum

Block V
Job
Operation

Teaching Objective: To teach students to test engine vacuum

Tools: Vacuum gauge, vacuum-gauge hose and fittings, tachometer

Materials: Wipe cloths

Teaching Aids: Automobile or engine on stand

References: Motor's Auto Repair Manual
Automotive Mechanics, Crouse, Chapter 26

Steps:

1. Obtain the manufacturer's specifications for the engine
2. Remove the vacuum test plug in the intake manifold and connect the vacuum-gauge hose
3. Start the engine and set the speed at 400 to 500 r.p.m. using a tachometer
4. Note the reading on the vacuum gauge. A steady reading of from 19 to 21 in. indicates a satisfactory engine condition.
5. If the gauge pointer indicates low vacuum, gives an unsteady reading (pointer floats back and forth), or drops at regular intervals, the following inspections should be performed:
   a. Test spark plugs to determine that all are firing
   b. Adjust carburetor
   c. Check ignition timing
   d. Check valve clearances. Observe the vacuum reading after each test.
   e. Check cylinder compression

6. If the gauge pointer indicates less than 18 in., inspect the heat riser. Check for intake manifold leaks.

7. If the gauge pointer indicates 19 to 21 in. but drops back at irregular intervals, sticking valves are indicated.

8. Excessively rich carburetion is indicated by the gauge pointer floating back and forth, slowly, over a wide range. If the carburetor cannot be adjusted to overcome this condition, it must be removed and overhauled.

9. To test the muffler "back pressure," speed up the engine quickly and close the throttle instantly when the vacuum-gauge pointer registers zero. If the gauge pointer then climbs rapidly to 24 in. or better, a normal exhaust system is indicated.

10. Stop the engine and disconnect the vacuum-gauge hose. Replace and tighten any fittings that were removed to make the test.

11. Start the engine and adjust the idling speed to specifications

12. Stop the engine and review notes covering the test

OPERATION

Block: Engine

Operation: Testing for Cylinder Balance

Block V
Job
Operation

Teaching Objective: To teach students to test for cylinder balance

Tools: Test machine (Sun), tachometer, vacuum gauge

Materials: Wipe cloths

Teaching Aids: Automobile or engine on stand

References: Auto Service and Repair, Stockel, 1969, p. 23-7

Steps:

1. Connect tachometer and vacuum gauge
2. Run engine until normal operating temperature is reached
3. Start engine and run at fast idle (approx. 1500 R.P.M.)
4. Ground large clip of grounding leads and plugs except the pair being tested
5. Divide the firing order in half and write down the first half over the second half. The cylinders to be tested together appear one over the other.

Firing order	Pairs tested
1-8-4-3-6-5-7-2	1-6, 8-5, 4-7, 3-2
1-2-7-8-4-5-6-3	1-4, 2-5, 7-6, 8-3
1-5-4-8-6-3-7-2	1-6, 5-3, 4-7, 8-2
1-5-4-2-6-3-7-8	1-6, 5-3, 4-7, 2-8
1-8-7-3-6-5-4-2	1-6, 8-5, 7-4, 3-2
1-6-5-4-3-2	1-4, 6-3, 5-2
1-5-3-6-2-4	1-6, 5-2, 3-4
1-4-5-2-3-6	1-2, 4-3, 5-6
1-3-4-2	1-4, 3-2

6. Operate engine on each pair of cylinders in turn and note engine rpm and manifold vacuum for each pair

7. A variation of more than one inch of vacuum or 40 rpm between pairs of cylinders being tested indicates that the cylinders are off balance.

8. To isolate one weak cylinder, short out one bank of cylinders at a time. The bank giving the lower readings will include the weak cylinder.

Note: As with all service operations or tests requiring engine in operation, make certain that exhaust is vented to outside.

OPERATION

Block: Tune-up

Block V
Job
Operation

Operation: Adjusting Ignition Timing

Teaching Objective: To teach students to adjust ignition timing

Tools: Timing light, tachometer, screwdriver

Materials: Wipe cloths

Teaching Aids: Tune-up Manual, Ignition Manufacturer's Institute
Transparency:
- Engine Timing, p. 44

References: Motor's Auto Repair Manual, 1969, pp. 2-12
Automotive Mechanics, Crouse, Chapter 15

Steps:

1. Get the manufacturer's specifications for the ignition timing

   Note: On some cars it is necessary to disconnect the vacuum line at the distributor before making timing adjustments.

2. Locate the ignition timing marks on the engine flywheel or vibration damper

3. Clean the area around the ignition timing marks, so that the marks will be easily seen in the flash of the timing light

4. Use a chalk mark, if necessary for better timing mark indication

5. Connect the timing light according to the instructions for the light being used

6. Connect the tachometer according to instructions

7. Start the engine

8. Adjust the engine idling speed (using a tachometer) to the manufacturer's specifications

9. Direct the timing light toward the timing marks. If the timing is correct, the timing light flash will coincide with the appearance of the timing mark at the check point. If the timing is incorrect, proceed as follows:

   a. Loosen the clamp or lock screw on the distributor so that it may be turned

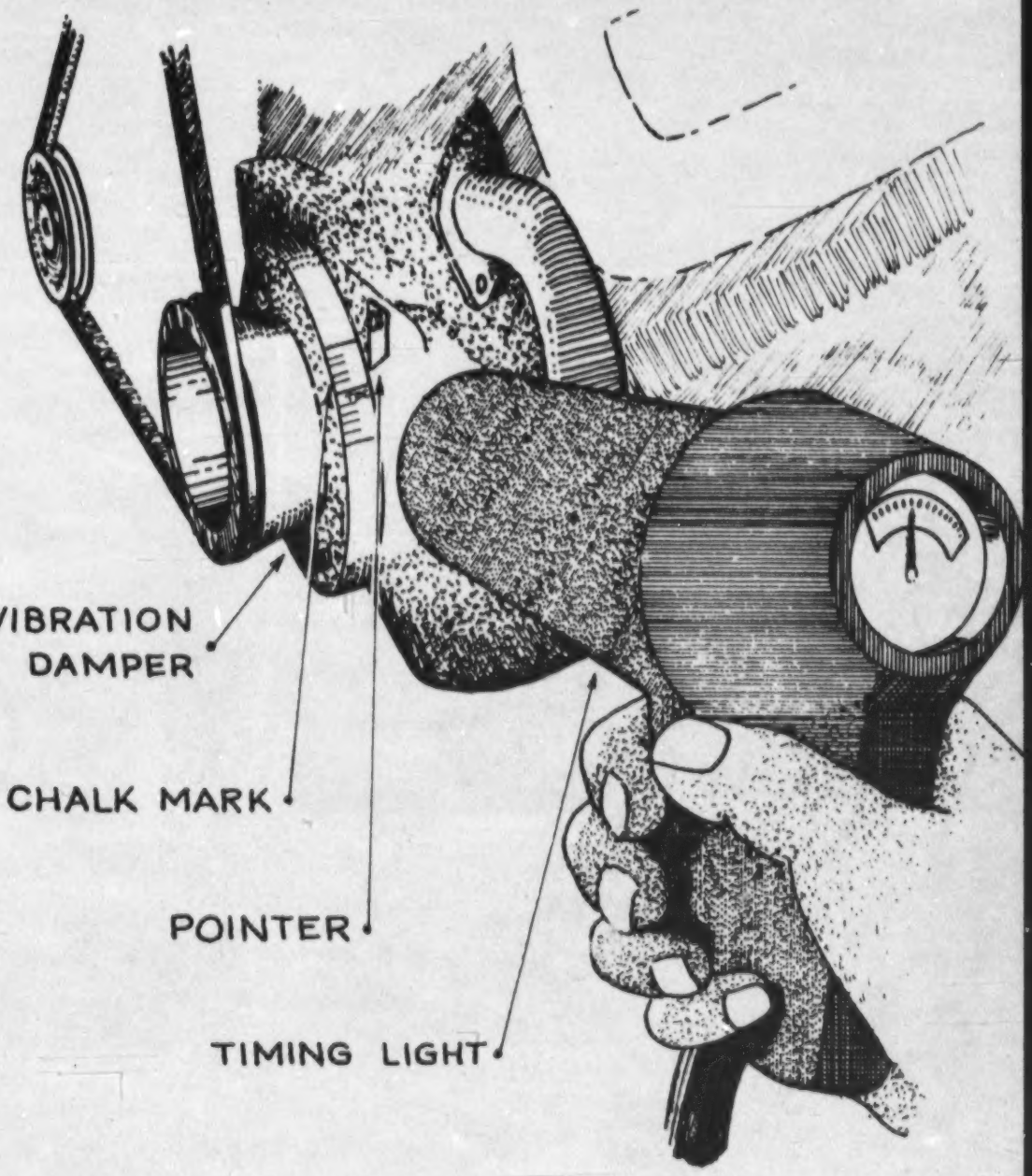
   b. Move the distributor clockwise or counterclockwise until the timing mark is synchronized with the timing flash at the timing check point

   c. Retighten the distributor clamp or lock screw

10. Increase the engine speed through the specified timing stages, checking the degree of advance at each stage, and comparing this with the manufacturer's specifications

11. Stop the engine and disconnect the timing light and tachometer

Engine Timing



INFORMATION

Block: Tune-up

Block V
Job
Lesson

Lesson: Spark Plug Classification

Teaching Objective: Upon completion of this lesson, students will be able to describe typical automotive spark plugs and relate certain classifying characteristics to normal spark plug functioning.

Teaching Aids: Samples of spark plugs
Champion Spark Plug Chart
Transparencies:
- Typical Spark Plug, p. V-46
- Spark Plug Seating, p. V-47

References: Facts about Spark Plugs and Engines, Champion Spark Plug Company
Auto Service and Repair, Stockel, 1969, pp. 21-22 - 21-31

Outline of Information:

1. Parts of spark plug

   a. Refer to transparency, "Typical Spark Plug"

   b. Standardized in the automotive industry

2. Size of plugs

   a. Determined by diameter (in mm.) of installation threads

   b. Reach is determined by length of threads.

3. Plug gap

   a. Controls length of spark required to ignite fuel mixture at all speeds

   b. Length of spark determined by gap

4. Heat range

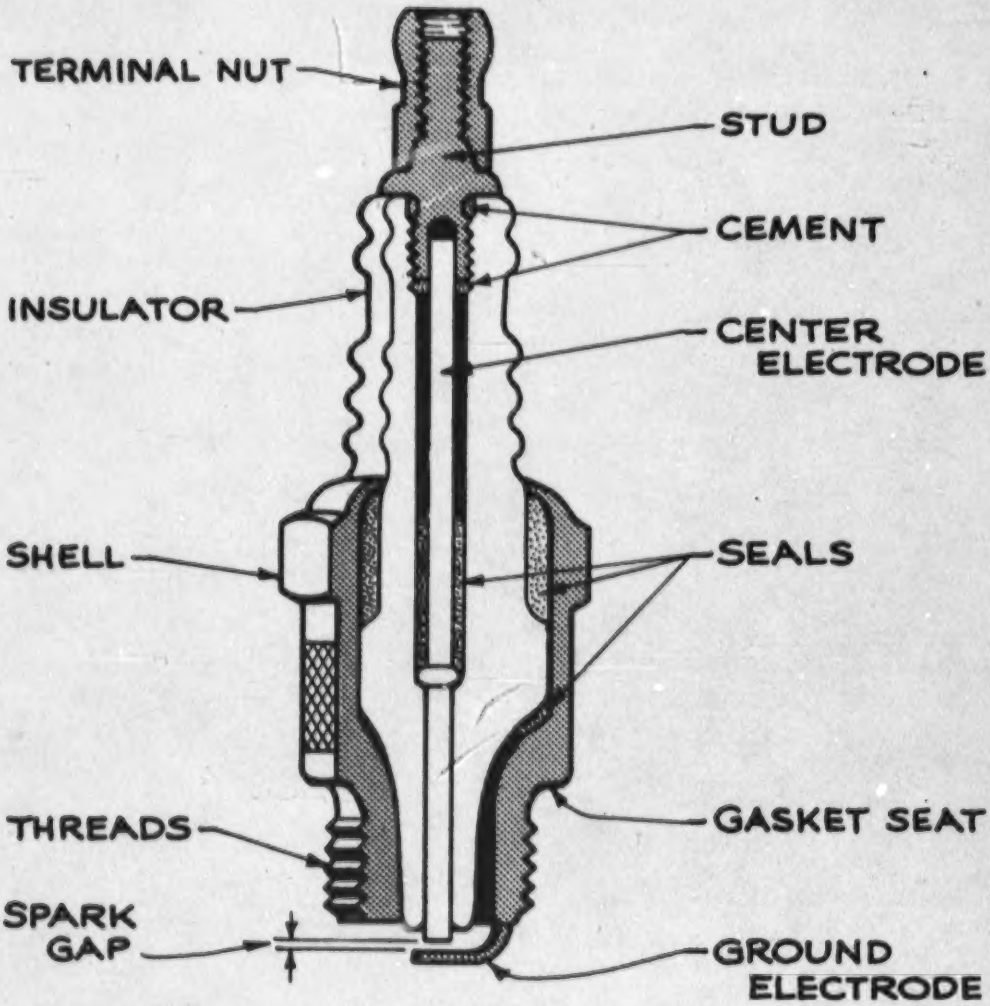
   a. Classification of plugs according to heat transfer ability
      -- Cold type (has short heat path)
      -- Hot type (has long heat path)

5. Voltage required to jump gap

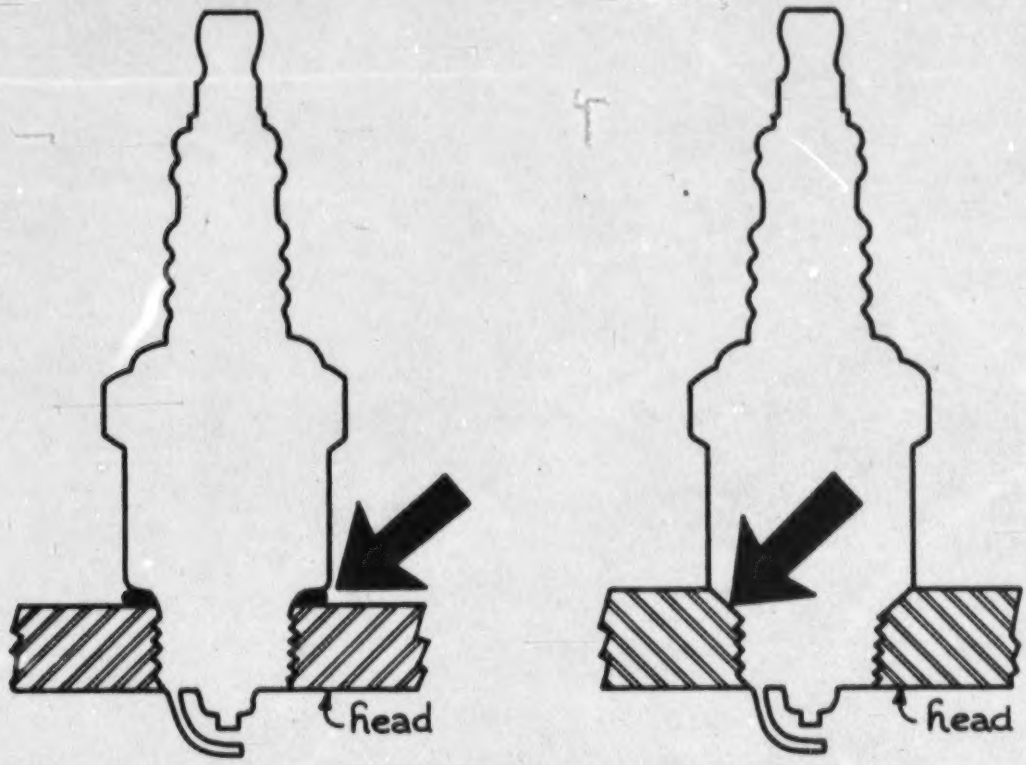
   a. Created in coil through primary/secondary induction

   b. Ranges (depending on system design) from 12,000 to 20,000 volts

TYPICAL SPARK PLUG



SPARK PLUG SEATING



SEAL RING TYPE

TAPER SEAT FOR SEALING

INFORMATION

Block: Tune-up

Lesson: Spark Plug Functioning

Block V
Job
Lesson

Teaching Objective: Upon completion of this lesson, students will be able to distinguish between proper and improper spark plug functioning and to associate various spark plug conditions with related system conditions.

Teaching Aids: Transparency:
-Spark Plug Operating Conditions, p. V-49

References: Facts About Spark Plugs and Engines, Champion Spark Plug Company

Outline of Information:

1. Normal operation

   a. Usually identified by white powdery deposits or rusty-brown to grayish-tan powdery deposits

2. Burned or overheated spark plugs

   a. Identified by white, burned or blistered insulator nose

   b. Badly burned electrodes

   c. Causes
      -- Improper fuel
      -- Insufficient cooling
      -- Improper ignition timing

3. Gas fouling (carbon deposits)

   a. Identified by dry, fluffy, black deposits

   b. Causes
      -- Over-rich air-fuel mixture
      -- Dirty air cleaner
      -- Faulty breaker points
      -- Sticking heat valve
      -- Slow speeds, excessive idling

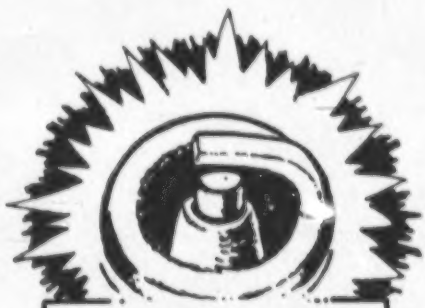
SPARK PLUG *Operating Conditions*

DEPOSIT FOULING

DEPOSIT FOULING

OIL FOULING

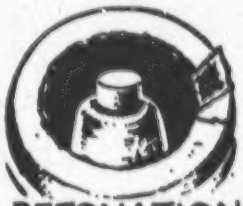
CARBON FOULING



NORMAL OPERATION

IMPROPER INSTALLATION

INSUFFICIENT INSTALLATION TORQUE



DETONATION

HEAT SHOCK FAILURE

PREIGNITION

OPERATION

Block: Tune-up

Operation: Servicing Spark Plugs

Block V
Job
Operation

Teaching Objective: To teach students to service spark plugs

Tools: Correct spark plug socket, tension wrench, spark plug gap tool, spark plug cleaning-testing machine, spark plug gap gauge

Materials: Wipe cloths, replacement plugs, plug gaskets (if necessary)

Teaching Aids: Automobile, engine on stand, practice spark plugs

References: Motor's Auto Repair Manual, 1969, p. 1-22
Auto Service and Repair, Stockel, 1969, p. 21-22 - 21-30

Steps:

1. Obtain the manufacturer's specifications for the spark plugs

2. Remove the wires from the spark plugs. Be sure that each wire can be identified correctly for reconnecting.

3. Use an air hose to clean all dirt and grit from the area around the spark plugs

4. Remove the spark plugs with the correct size spark plug socket

5. Remove and discard the spark plug gaskets (copper rings)

6. With an abrasive blast cleaner, clean the plugs until the carbon-deposits have been removed and the inside insulator is clean

   Note: Do not over-clean with abrasive blast, as side electrode and insulator may be destroyed

7. Wipe the outside insulator. Clean with a cloth slightly dampened with water.

8. Examine the plugs carefully. If the insulator is cracked, blistered, or broken, or if the electrode is burned away, the plug should be replaced.

9. Check the spark plug gap. If incorrect, reset the gap to the manufacturer's specifications. Bend only the side (grounded) electrode to obtain the correct gap setting.

10. Test the plugs in a testing machine (Do not attempt to test the plugs until they have been cleaned and reset.)

11. Install new gaskets on the spark plug bases (if gasket type)

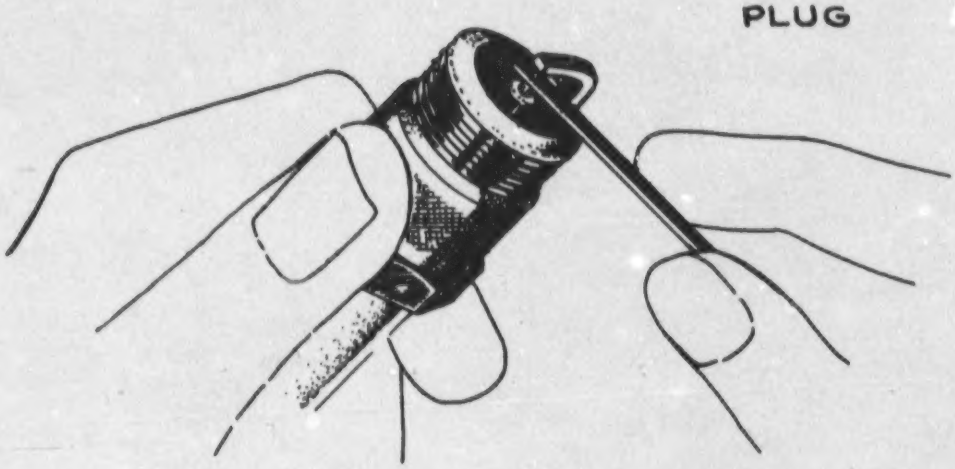
12. Install the spark plugs in the engine. Tighten them by hand.

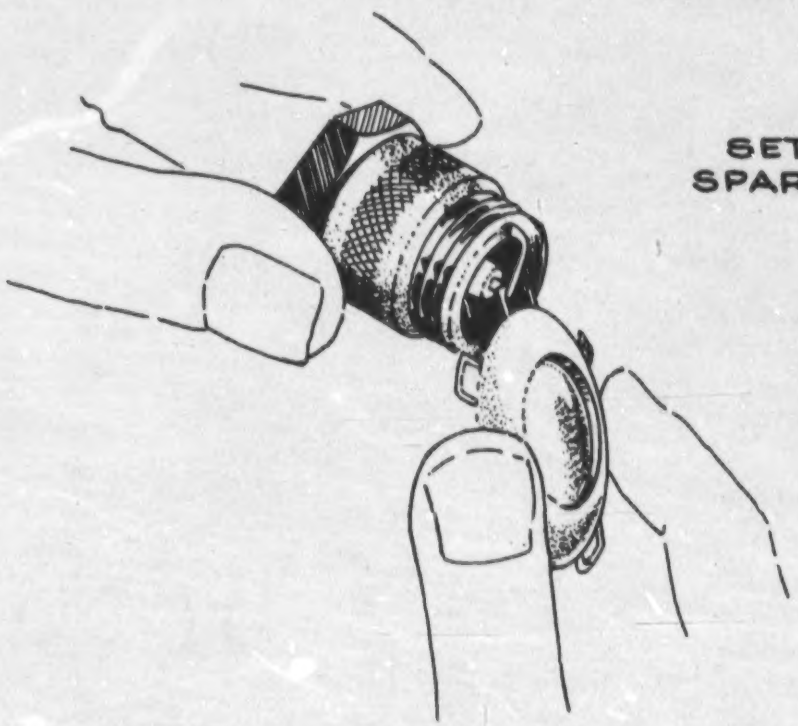
13. Use a torque wrench to tighten the plugs to recommended torque

14. Connect the spark plug wires to the spark plugs in the proper order

SPARK PLUG
FILING AND SETTING GAP

FILING
PLUG





SETTING
SPARK PLUG

INFORMATION

Block: Tune-up

Block V
Job
Lesson

Lesson: Spark Plug Wires (Secondary Ignition Wiring)

Teaching Objective: Upon completion of this lesson, students will be able to state the purpose of secondary ignition wiring and to describe the construction features of the two most common types.

Teaching Aids: Samples of types of spark plug wires
Transparencies:
- Automotive Wiring, Block III
- Terminals, Block III
- Ignition Power Circuit, p. V-5

References: Auto Service and Repair, Stockel, 1969, p. 21-7
Charging, Ignition and Cranking Systems, Delco-Remy, pp. 33-34

Outline of Information:

1. The purpose of spark wires is to deliver secondary voltage from distributor to spark plugs.

2. Types

   a. Standard
      -- Not commonly used in modern passenger vehicles
      -- Usually stranded copper or aluminum with rubber or neoprene insulation

   b. Resistance Type
      -- Used in most modern vehicles to comply with regulations pertaining to communications interference standards
      -- Carbon-impregnated nylon core
      -- Graphite-saturated fiber-glass core

OPERATION

Block: Tune-up

Operation: Replacing Spark Plug Wires

Block V
Job
Operation

Teaching Objective: To teach students to replace spark plug wires

Tools: Terminal crimping tool or soldering iron, wire cutters

Materials: Spark plug wires, spark plug wire distributor terminals, spark plug wire connectors

References: Charging, Ignition and Cranking Systems, Delco-Remy, p. 34

Steps:

1. Note the firing order of the engine
2. Determine the rotation (clockwise or counter-clockwise) of the distributor rotor
3. Mark the location of the No. 1 spark plug wire on the distributor cap for reference
4. Note how the spark plug wires are located in the cable holder bracket
5. Disconnect all the wires at the spark plugs
6. Remove the distributor cap and the spark plug wires
7. Remove the wires from the distributor cap and clean the distributor cap wire connector sockets
8. Wash the distributor cap in carbon tetrachloride and inspect it for cracks. If the cap is cracked or the center contact in the cap is worn, the distributor cap should be replaced.
9. Install the distributor cap. Be sure that the cap positioning plug is in place on the distributor housing.

10. Cut new spark plug wires to the proper length (match with the old wires for length) and attach the terminals. Crimp or solder the terminals to assure good contact.

    Note: Many modern vehicles use a wire of carbonized core nylon which cannot be soldered. These resistance wires must be handled carefully to avoid loosening terminal and cable connections.

11. Install the No. 1 spark plug wire in the distributor cap connector socket marked No. 1

12. Install the remaining spark plug wires in the distributor cap in the order the engine should fire. Work from No. 1 wire in the direction that the rotor will travel.

13. Connect all the spark plug wires to the plugs

14. Recheck the entire installation. Start the engine and test the secondary current at each spark plug.

INFORMATION

Block: Tune-up — Block V
Job
Lesson: Transistorized Ignition System — Lesson

Teaching Objective: Upon completion of this lesson students will be able to define the purposes of using a transistorized ignition system, identify the two basic types and list their differences.

Teaching Aids: Transparencies:
- Power and Ignition System, p. V-2

References: Motor's Auto Repair Manual, 1969, pp. 1-47 - 1-52
Automotive Mechanics, Crouse, Chapter 15

Outline of Information:

1. Purpose of transistorized ignition

   a. Basic purpose is identical to that of standard system
      -- To efficiently deliver ignition spark to each cylinder at proper time

   b. Secondary purposes
      -- Better performance
      -- Operating efficiency improved
      -- Parts of system subject to less wear - therefore, longer life

   c. Used on racing and other high performance engines

2. Types

   a. Capacitor discharge type
      -- Amplifier has no moving parts
      -- Circuit contains transistors, diodes, resistors, thyristor, transformer
      -- Printed circuit
      -- Delivers 30,000 volts instantaneously
      -- Will fire worn or damp spark plugs
      -- Spark plug life is extended
      -- Faster cold weather starting
      -- Constant ignition power is maintained while cranking even if battery voltage drops

Transistorized Ignition (Continued)

b. Transistor controlled type
   -- Amplifier has no moving parts.
   -- Circuit contains transistors, resistors, diodes, condensors
   -- Printed circuit
   -- Ballast resistors regulate by-pass of resistance during cranking.

c. Magnetic pulse distributor
   -- Used in both systems
   -- Contains no breaker point system
   -- Iron timer core replaces breaker cam.
      (1) Core rotates inside magnetic pick-up assembly.
      (2) Core has same number equally spaced cam projections as number of engine cylinders.
      (3) Vacuum advance and centrifugal weight system is conventional.

d. Third type system
   -- Utilizes both transistorized regulation for even power control and breaker points in distributor
   -- Advantage is that transistor system action breaks primary coil circuit instead of points.
   -- Points last longer - gap remains at proper setting.

OPERATION

Block: Tune-up

Block V
Job
Operation

Operation: Removing Distributor (Transistor System)

Teaching Objective: To teach students to properly remove the distributor from the transistorized system

Tools: Combination wrenches (1/2" and 9/16"), Distributor wrench (9/16"), ignition wrench set, screwdriver

Materials: Wipe cloths

Teaching Aids: Automobile or engine on stand

References: Vehicle Service Manual
Automotive Mechanics, Crouse, Chapter 26

Steps:

1. If vehicle is equipped with radio, remove three bolts securing ignition shield over distributor and coil. One bolt is accessible from the top of shield, the other two are at rear of shield, facing firewall.

2. Disconnect tachometer drive cable from distributor housing

3. Disconnect pickup coil leads at connector

4. Remove distributor cap

5. Crank engine so rotor is in position to fire No. 1 cylinder and timing mark on harmonic balancer is indexed with pointer

6. Remove vacuum line from distributor

7. Remove distributor clamping screw and hold-down clamp

8. Remove distributor and distributor-to-block gasket

   Note: The rotor will rotate as the distributor is pulled out of the block. Mark the relationship of the rotor and the distributor housing after removal so that the rotor can be set in the same position when the distributor is being installed

OPERATION

Block: Tune-up — Block V
Job
Operation: Installing Transistor Ignition Coil — Operation

Teaching Objective: To teach students to install a transistor ignition distributor

Tools: Distributor wrench (9/16"), screwdriver, needle-nose pliers, and ignition set

Materials: Wipe cloths, gaskets

Teaching Aids: Automobile or engine on stand equipped with system

References: Vehicle Service Manual
Motor's Auto Repair Manual, 1969, p. 1-49

Steps:

1. Check to see that the engine is at firing position for No. 1 cylinder (timing mark on harmonic balancer index with pointer)
2. Position a new distributor-to-block gasket on the block
3. Before installing distributor, index rotor with housing as noted when distributor was removed. Install distributor in block so that vacuum diaphram faces approximately 45° forward on the right side of the engine and the rotor points toward contact in cap for No. 1 cylinder.
4. Replace distributor clamp leaving screw loose enough to allow distributor to be turned for timing adjustment
5. Install spark plug wires in distributor cap. Place wire for No. 1 cylinder in tower (marked on old cap during assembly) then install remaining wires clockwise around the cap accordirg to the firing order (1-8-4-3-6-5-7-2).
6. Attach distributor to coil primary wires
7. Replace distributor cap
8. Adjust timing and then fully tighten distributor clamp screw
9. Attach vacuum line to distributor
10. Connect tachometer drive cables to distributor body
11. Replace ignition shields

OPERATION

Block: Tune-up — Block V

Job

Operation: Disassembling the Transistor Distributor — Operation

Teaching Objective: To teach students to disassemble the transistor distributor

Tools: Distributor wrench (9/16"), screwdriver and ignition set, needle-nosed pliers, pin punch, ball pein hammer

Materials: Wipe cloths

Teaching Aids: Automobile, engine on stand or practice ignition system

References: Vehicle Service Manual
Motor's Auto Repair Manual, 1969, pp. 1-48 - 1-49

Steps:

1. Remove screws securing rotor and remove rotor
2. Remove centrifugal weights spring and weights
3. Remove the tachometer drive gear from the distributor (Corvett only)
4. Remove roll pin, then remove distributor drive gear and washer

   Note: To prevent damage to the permanent magnet, support drive gear when driving out roll pin

5. Remove drive shaft assembly
6. Remove centrifugal weight support and timer core from drive shaft
7. Remove connector from pickup coil leads
8. Remove retaining ring which secures magnetic core support plate to distributor shaft bushing in housing
9. As a unit, remove the entire magnetic pickup assembly from the distributor housing
10. Remove brass washer and felt pad
11. Remove vacuum advance unit
12. To reassemble distributor, perform the above steps in reverse order

OPERATION

Block: Tune-up

Block V
Job
Operation

Operation: Disassembling Ignition Pulse Amplifier

Teaching Objective: To teach students how to disassemble a pulse amplifier

Tools: Screwdriver, socket set (1/4")

Materials:

Teaching Aids: Automobile, engine on stand, practice ignition components

References: Vehicle Service Manual

Steps:

1. Remove the bottom plate from the amplifier

   Note: To aid in reassembly, identify locations of the lead connections to panel board

2. Remove the three panel board attaching screws, and lift the assembly from the housing

   Note: To aid in reassembly, check for identifying markings on the two transistors and their respective locations on the panel board and heat sink-assembly

   Check the insulators between the transistors and the heat-sink from the panel board

3. Remove the transistor attaching screws, and separate the two transistors and heat-sink from the panel board

4. Carefully examine the panel board for evidence of damage

MINOR TROUBLE SHOOTING GUIDE

If your car acts in the following manner:

Check here in sequence shown for possible causes.

	FUEL SYSTEM AND ENGINE								ELECTRICAL SYSTEM									COOLING SYSTEM			
	Check Fuel Gauge	Flooded Carburetor	Empty Carburetor Bowl	Poor Fuel Supply to Carburetor	Idle Adjustment	Automatic Choke	Oil Level and Pressure	Condition of Air Cleaner	Malfunctioning Ignition Switch	Automatic Transmission Selector Lever	Check Spark	Battery and Connections	Generator and Voltage Regulator Connections	Coil and Distributor Leads	Starter Connections and Solenoid	Damp Electrical Connections	Generator Condition	Radiator Coolant Level	Air Flow Through Radiator Restricted	Fan Belt Condition and Tension Adjustment	Thorough Check and Tune-Up Suggested
CAR WILL NOT START:																					
Engine Will Turn Over	1	4		3							6			2		5					7
Engine Will Not Turn Over									2	1		3			4						5
CAR WILL START—BUT:																					
Only After Repeated Tries																					1
Stalls in a Few Seconds			2	1	3																
Stalls When Hot					1	2		3													4
Idles Rough					1			2													3
Engine Overheats																		1	2	3	
"Oil" Indicator Light Comes On							1														
"Gen" Indicator Light Comes On				3								4	2				5			1	

This chart is designed to point out possible solutions to several of the most common automotive malfunctions and point out a logical checking sequence.

Courtesy: Bendix
Automotive Service Division
South Bend, Indiana

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